

within the diseased berries retains its vitality during the winter months and through the agencies of warmth and moisture of early spring and summer the asci and sporidia are produced.

The germination of these sporidia has never been observed, but if by any system of culture they can be made to reproduce the *Phoma* of the Black Rot their real nature will be settled beyond dispute.

EXPLANATION OF PLATE IX. Fig. 1. A fragment of epidermis of a diseased berry, showing five of the black "pustules" formed by the development of the pycnidia. From four of these slender, contorted, worm-like filaments are being extruded; these are the stylospores held together by a kind of mucilage.

Fig. 2. A section through a bit of the berry, including a pycnidium (P) and a spermagonium (S). At O is the ostium of the pycnidium through which the spores escape at maturity.

Fig. 3. A section of a portion of a pycnidium, more highly magnified, showing the basidia.

Fig. 4. Three stylospores germinating.

Fig. 5. A section through the perithecium or conceptacle of the ascospore form, showing the asci, etc.

Fig. 6. Two separate asci, showing the 8 sporidia in each.

Fig. 7. Four of the sporidia that have escaped from an ascus.

Fig. 8. An ascus, enclosing 8 sporidia, found June 2, 1886, in grape (destroyed in 1885 by "Black Rot") kept for a week in moist air. From camera lucida sketch made by Erwin F. Smith in the laboratory of the University of Michigan. Mr. Smith notes that the "receptacles containing the asci are numerous, and the asci themselves abundant."

## Synopsis of North American Pines, based upon leaf-anatomy. II.\*

JOHN M. COULTER AND J. N. ROSE.

8. *P. monophylla* Torr. & Frem. Section almost circular: stomata in 18-26 rows: number of ducts two<sup>4</sup> (.055-.115 mm.): number of cells in bundle-sheath 30-55: strengthening cells in fibro-vascular region: leaf 1 to 2 in. long.

In the Sierra Nevada and mountains of California.

The single leaf serves well to distinguish this species. It has been considered a single leaf or a connate pair, but its minute structure at once decides that it represents but one of the two leaves found in *P. edulis*, and the notion

\*Continued from page 262.

<sup>4</sup>Dr. Engelmann, in *Bot. Calif.* ii. 124, says that the ducts vary from 2 to 14, but we have found but two. Our specimens have included the type.

that the two leaves of the latter are the representatives of the one in *P. monophylla* can not be held for a moment. If, therefore, *P. monophylla* and *P. edulis* intergrade it can only be on the supposition that an entirely new leaf is formed. Dr. J. S. Newberry<sup>5</sup> states that he has observed the two species running together, and that in certain intermediate regions he has seen trees upon which both single and double leaves were found. This would surely indicate a very close relationship, borne out by their minute structure, but in the absence of specimens from these intermediate forms we would suspend judgment. Dr. Hooker<sup>6</sup> still claims, from his own observations, that they are distinct. If Dr. Newberry's testimony is confirmed by a study of the minute structure of these intermediate forms the question would seem to be settled.

9. *P. edulis* Engelm. Closely resembling the last, but the much smaller section semicircular (2-leaved) or rarely triangular (3-leaved): stomata in 5-15 rows: ducts .030-.060 mm.: number of cells in bundle-sheath 15-40: leaves somewhat shorter.

S. Colorado, New Mexico, and W. Texas.

The 3-leaved forms of *P. edulis* we have received raise the question whether they should not rather be referred to the next species, not so much on account of the 3-leaved character, but because it is accompanied by the absence of dorsal stomata.

+ + No stomata on dorsal side of leaf.

++ Dorsal side of leaf much broader than either ventral: cuticle not specially thickened: stomata not deeply set, the subsidiary cells even forming slight protuberances.

10. *P. cembroides* Zucc. No ventral furrows: stomata in 4-6 rows: dorsal ducts two, nearer the edge than the middle (.025-.040 mm.), completely surrounded by strengthening cells, which are also in fibro-vascular region: leaves (3) slender, 1-2 in. long.

Throughout the southwestern mountains and Mexico.

Occasional specimens of this species show stomata on dorsal side of leaf and hence a close relationship to the preceding group.

11. *P. latisquama* Engelm. Like the last, but with a broad furrow on each ventral face: ducts smaller (.020-.030 mm.), not always completely surrounded by strengthening cells: leaves more slender and longer.

Mexico.

12. *P. Parryana* Engelm. Resembling *P. cembroides*, but with section much (often twice) larger: stomata in 8-10 rows:

<sup>5</sup> *Bulletin Torrey Bot. Club*, xii. 50; xiii. 183.

<sup>6</sup> *Gardener's Chronicle*, July 31, 1886.

ducts much larger (.050–.090 mm.): leaves (mostly 4) shorter and much thicker.

S. California and southward into Lower California.

In reference to this whole group of "nut pines" (the last five species) Dr. Engelmann<sup>7</sup> says "it is an open question whether these species may not properly be united into one, as the difference of flowers and fruit is very slight, and that of foliage is only relative." We have been able to separate them upon the characters given, but do not claim that they should be kept specifically distinct. It is evident that they are very closely related, and if the differences noted do not serve to make them specifically distinct they will all have to be included under one species. For the present it seems better to keep them separate.

++ ++ Dorsal side of leaf about as broad or narrower than either ventral: cuticle often much thickened, and stomata very deeply set: leaves in fives.

13. **P. Balfouriana** Murray. Strengthening cells about two layers, sometimes three in the angles, very few in fibro-vascular region: ducts dorsal, two (.040–.080 mm.), always completely surrounded by strengthening cells, position as in *P. cembroides*, or nearer the middle, sometimes parenchymatous: leaves 1–1½ in. long.

Mountains of California.

14. **P. aristata** Engelm. Resembling the last, but strengthening cells fewer, but one layer next the epidermis, sometimes two on the dorsal side or at the angles, and an incomplete sheath or none at all about the ducts: dorsal ducts one or two, smaller (.025–.050 mm.), near the middle of the dorsal face, often quite close together: leaves as in the last.

Mountains of Colorado, Arizona and westward.

In *Bot. Wheeler's Report*, p. 375, Dr. Engelmann reduces this species to a variety of *P. Balfouriana*. Judging from its leaf structure it should be restored to specific rank, for it is more distinct than many that are kept separate, and its superficial characters confirm this claim.

‡ 2. Fibro-vascular bundles two: ducts mostly parenchymatous or internal.

\* Ducts parenchymatous (mostly peripheral in *P. resinosa*).

+ Bundle-sheath thick-walled (except sometimes in *P. Sabiniana*)

++ A thin-walled layer next the epidermis.

= Leaves in pairs.

<sup>7</sup> Trans. St. Louis Acad. IV. 178.

a. Strengthening cells about ducts, but none in the cortical region. Atlantic species.

15. *P. resinosa* Ait. Thin-walled cells small, tangentially oblong, not half as large as the epidermal cells: leaves 5-6 in. long.

Massachusetts to Minnesota.

The ducts are mostly peripheral, as in the first section, though parenchymatous ones are quite common. This species seems to form a sort of transition between the two sections, which are apparently quite widely separated here owing to the absence of about a dozen Old World species.

b. Strengthening cells in the cortical region, but none about ducts: Pacific coast species.

16. *P. contorta* Dougl. Thin-walled cells as in *P. resinosa*, and about half as large as the strengthening cells, which mostly form but one continuous row interrupted only by stomata: ducts one or two, often wanting, larger than in the next species (.050-.090mm.): leaves 1-1½ in. long.

All along the Pacific coast.

When old the leaf structure resembles that of *P. Banksiana* and *P. inops*.

17. *P. muricata* Don. Thin-walled cells larger than in the preceding, only a little smaller than the epidermal and larger than the strengthening cells: ducts 2-9, very small (.025-.040 mm.): leaves 4-6 in. long.

Along the coast of California.

This species has been confounded with forms of *P. contorta*, but they are well distinguished by the characters given above.

= = Leaves in threes (sometimes fours or fives): ducts 2-10.

18. *P. Engelmanni* Carr. Strengthening cells abundant in cortical region, extending half way to the ducts; rarely any about the ducts; abundant in fibro-vascular region: ducts 8-10, very small (.020-.030 mm.): leaves 13-15 in. long.

Mountains of Mexico.

Our description of this little known species is taken from specimens obtained from the Harvard herbarium. Dr. Engelmann describes the single specimen obtained by Wislizenus, in 1846, as having "strongly developed strengthening cells around the ducts," a character which our specimens do not show. The strengthening cells are unusually developed and are often larger than the epidermal cells. Parlatores considered this species a form of *P. Montezumæ*, but its leaf structure is very distinct from what is found even in that polymorphous species.

19. *P. Coulteri* Don. Strengthening cells larger than the epidermal cells, in the cortical region broken into heavy bundles by the frequent rows of stomata; sometimes about the ducts; very numerous in fibro-vascular region on both sides: ducts 4-10, quite variable in size (.025-.100 mm.), sometimes internal: leaves 6-12 in. long.

Along the Pacific coast.

20. *P. ponderosa* Dougl. Strengthening cells smaller than epidermal cells, in 1 to 3 rather regular rows in the cortical region; also about the ducts: ducts mostly two, often five or more, quite variable in size (.030-.070 mm.): leaves 5-11 in. long.

Generally distributed throughout the Rocky Mountains and westward.

31. *P. tuberculata* Gordon, may be looked for in this group.

= = = Leaves in fives: ducts always 3, one in each angle.

21. *P. Arizonica* Engelm. of S. Arizona, and

22. *P. Montezumæ* Lamb. of Mexico, can not be separated by leaf characters. The latter species has a wide range of forms, and is but poorly circumscribed. It is quite possible that further knowledge of external characters may require these two species to be reduced to one. All the forms have well developed strengthening cells.

++ ++ No thin-walled layer next the epidermis: strengthening cells about ducts and in fibro-vascular region.

= Leaves in fives: stomata deeply set.

19. *P. Coulteri* Don. may be looked for in this group.

23. *P. Torreyana* Parry. Outline of section mostly triangular: stomata numerous, 8-13 rows on each face: 3-5 rows of strengthening cells in cortical region: ducts mostly 3 (.040-.060 mm.), sometimes with accessory internal ones: leaves 8-11 in. long.

Coast of Southern California.

= = Leaves in threes: stomata not deeply set.

24. *P. Jeffreyi* Murray. Strengthening cells in 2 or 3 rows in cortical region; one complete row about ducts: ducts two or more (.040-.060 mm.): leaves 4-9 in. long.

Eastern slope of the Sierras and ranging into Oregon.

The leaf structure is much like that of *P. ponderosa*, to which species it is often referred as a variety, but is very distinct in the absence of the sub-epidermal thin-walled layer.

25. *P. Sabiniana* Dougl. Strengthening cells in bundles in cortical region, and usually about ducts; which are mostly two (.020-.050 mm.): the cells of the bundle-sheath are often thin-walled, and the species may be looked for under the next group: leaves 8-12 in. long; the section considerably smaller than in *P. Coulteri*, with which it may be confused.

Mountains of California.

+ + Bundle-sheath thin-walled: a thin-walled layer next the epidermis.

++ Strengthening cells in fibro-vascular region; few, if any, about ducts.

= Leaves in threes.

26. *P. Tæda* L. Strengthening cells in the angles much larger than epidermal cells, in the rest of the cortical region only about half as large; also on dorsal side in fibro-vascular region: ducts quite large for the section (.037-.075 mm): leaves 5-6 in long.

Delaware to Florida and westward to Arkansas.

27. *P. serotina* Michx. Strengthening cells equalling the epidermal cells, or smaller, numerous in the angles, elsewhere in the cortical region in bundles or single layers; generally absent from the ducts; in the fibro-vascular region on either or both sides of the fibro-vascular bundles: cells of the thin-walled layer quite small: ducts mostly 5-7, often half of them internal (.025-.050 mm.): leaves 6-8 in. long.

From N. Carolina to Florida.

28. *P. rigida* Miller. Like the last, but strengthening cells not so numerous in the cortical region, in two or three rows, about the size of the epidermal cells, or larger in the angles: ducts 3-7: leaves 3-5 in. long.

From New Brunswick to Kentucky.

29. *P. insignis* Dougl. Epidermal cells forming an arch next the stomata, making an oval cavity which opens below: strengthening cells (as well as thin-walled layer) mostly larger than epidermal cells, in one or two rows in the cortical region; sometimes found in the fibro-vascular region: leaves 4-6 in. long.

Coast of California.

19. *P. Coulteri* Don., and

31. *P. tuberculata* Gordon, may be looked for in this group.

= = Leaves in pairs.

30. *P. pungens* Michx. Thin-walled cells quite small:

strengthening cells in small bundles separated by the rows of stomata, much more numerous and larger in the angles; generally present in the fibro-vascular region: leaves 1-2½ in. long.

In the mountains from Pennsylvania to Tennessee.

++ ++ No strengthening cells in fibro-vascular region, nor about the ducts.

= Leaves in threes.

31. *P. tuberculata* Gordon. Thin-walled cells smaller than epidermal: strengthening cells in one or two rows, larger than the epidermal cells; rarely some about ducts and on dorsal side of fibro-vascular region: ducts 2 to 5, small (.020-.030 mm.), often with several internal.

Throughout the western mountain systems.

23. *P. Tæda* L., and

26. *P. insignis* Dougl. may be looked for here.

= = Leaves in pairs.

32. *P. inops* Ait. Epidermal and strengthening cells about the same size and quite small, the latter in a single layer: lines of stomata quite numerous: ducts occasionally internal: fibro-vascular bundles often widely separated: leaves 1½-3 in. long.

Along the coast from New York to S. Carolina, westward through Kentucky to Indiana.

33. *P. clausa* Vasey. Lines of stomata 10-20: strengthening cells often entirely wanting, or with a few scattered peripheral ones: ducts mostly two, one of which is occasionally internal, varying but little in size (.030-.035 mm.): leaves but half as wide (1 mm.) and longer than the last.

Florida.

34. *P. mitis* Michx. But one layer of strengthening cells, which are little smaller than the epidermal: ducts small (.020-.030 mm.), often as many as six: leaves 3-5 in. long, not twice as wide as thick.

New York to Florida, westward to Texas and Kansas.

35. *P. glabra* Walt. Ducts rather large (.050-.060 mm.) for the group, fewer than in the last, mostly 2 or 3, sometimes with one of them internal: leaves 3-4 in. long, twice as wide as thick.

South Carolina to Florida and through the Gulf States to Louisiana.

36. *P. Banksiana* Lamb. Cells of thin-walled layer smaller

than strengthening cells: ducts (.030-.060 mm.) sometimes wanting: leaves 1 in. long.

In the northern States.

30. *P. pungens* Michx. may be looked for here.

\* \* Ducts always internal: bundle-sheath thin-walled.

37. *P. palustris* Miller. Cells of thin-walled layer generally much smaller than those of the epidermis: strengthening cells mostly on ventral side of fibro-vascular region: ducts variable in size (.040-.050 mm.), with few strengthening cells: leaves 10-15 in. long.

*P. australis* Mx.

Virginia to Texas.

38. *P. Cubensis* Griseb. Cells of thin-walled layer large, often equalling those of the epidermis: strengthening cells about as large as epidermal, mostly but one layer; sometimes more in the angles, and even extending to the ducts; none about the ducts nor in fibro-vascular region: ducts variable in size (.050-.080 mm.), often with accessory parenchymatous ones: fibro-vascular bundles but little separated, often blended: leaves 7-12 in. long.

*P. Elliottii* Engelm.

South Carolina and Florida.

NOTE.—We would be pleased to receive from our friends specimens for identification, as doubtless a wider range of forms will lead to some modifications.

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## BRIEFER ARTICLES.

**A case of teratology.**—It is not always that the continuity of the leaf-spiral can be readily demonstrated with opposite or whorled leaves. Teratology sometimes helps us out. A stem of the garden valerian, *Valeriana officinalis*, was lately found which had grown to several times the usual diameter and become much shortened and spirally twisted. Where the tissues of the stem were nearly horizontal the leaf-spiral was nearly vertical and the leaves were inserted vertically with their buds at the side. The twisting, as is common with monstrous formations of the stem, was confined to the single axis.

A. A. CROZIER.

***Puccinia Malvacearum* Mont. in Massachusetts.**—I have recently received some leaves of hollyhock from the garden of Prof. C. L. Jackson, at Beverly, Mass., which were attacked by the true *Puccinia Malvacearum* common in many parts of Europe. In all respects the leaves attacked resemble